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FIELD DEMONSTRATION OF THE ICE 250™ CLEANING SYSTEM AT THE ROCKY MOUNTAIN OILFIELD TESTING CENTER CASPER, WYOMING

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ABSTRACT

The ICE 250™ Cleaning System was engineered to convert water into small ice particles for use in cleaning and decontamination applications. Ice crystals are produced in a special icemaker and pressured through a hose-nozzle onto the surface to be cleaned. The Rocky Mountain Oilfield Testing Center (RMOTC) and Ice Cleaning Systems, Inc. conducted a test of this system at Naval Petroleum Reserve No. 3 to evaluate the system's cleaning capabilities in an oil field environment. Equipment cleaned included an oil storage tank, a rod pumping unit, a road grader and a wellhead. Contaminants were unrefined sour crude oil, hydraulic fluid, paraffin and dirt, occurring separately and as mixtures. In all four demonstration cleaning tasks the ICE 250™ System effectively removed surface contaminant mixtures in a timely manner and left no oily residue. A minimal amount of waste moisture was generated, thereby reducing cleanup and disposal costs.

INTRODUCTION

Ice Cleaning Systems is an Indiana-based corporation that markets the ICE 250 **J** Cleaning Machine. The corporation entered a Cooperative Research and Development Agreement (CRADA) with RMOTC to demonstrate the effectiveness of the ICE 250 **J** Cleaning System in removing oil and grease from oil field equipment. The primary scope of the field demonstration was to clean a variety of oil field equipment in order to document the effectiveness of the ICE 250 **J** Cleaning System in an oil field environment.

PRODUCT DESCRIPTION

The ICE 250 **J** Cleaning Machine converts water into small ice particles that are then used for cleaning and decontamination applications. Ice crystals are formed in a special icemaker housed within the main unit. Using compressed air, the ice particles are forced through a hose to a blast-head (nozzle) that directs the crystals onto the surface to be cleaned. The ice particles exit the nozzle at the melting point of ice (32° F). As these particles impact the contaminated surface and change from solid to liquid, they deform laterally to exert a shear force. This force removes contaminants in a non-abrasive manner. Chemicals or abrasives are not added to the source water.

The ICE 250 **J** Cleaning Machine requires a power source of 440 volts AC, three phase, at 30 amps. The unit weighs 1,200 pounds with dimensions of 50"L x 46"W x 54"H. The ice-making unit is a non-chlorinated fluorocarbons (CFC) refrigeration system that uses water at a maximum rate of 25 U.S. gallons per hour. Ice particles are distributed using compressed air at a rate of 100-250 pounds per square inch per gallon (psig) @ 250 standard cubic feet per minute (scfm). The system is dustless and nontoxic; special personal protective equipment is not required during operation, although hearing protection is recommended.

RMOTC TEST DESCRIPTION

Although the ICE 250**J** Cleaning Machine has been used in chemical plants, pulp-paper plants, food processing plants, and for general industrial cleaning, it had not been tested in an oil field environment. On August 18—19, 1999 RMOTC and Ice Cleaning Systems, Inc. conducted a demonstration test of the ICE 250**J** Cleaning Machine at Naval Petroleum Reserve No. 3 (NPR-3). The purpose of the test was to evaluate the ability of the ICE 250**J** Cleaning System to remove dirt, grease, unrefined crude oil and other contaminants from various types of oil field equipment. Ice Cleaning Systems, Inc. provided a complete cleaning system. RMOTC provided a water source for the icemaker and personnel to operate the cleaning machine.

The Ice Cleaning Systems, Inc. demonstration system consisted of the following equipment:

- ICE 250**J** Cleaning Machine
- Set of high pressure hoses and nozzle assembly
- Hoses to connect the icemaker to source water
- Generator to provide electrical power
- Air compressor to supply pressure to nozzle assembly

The specific equipment used in the test operates at a maximum rate of 25 U.S. gallons per hour, maximum pressure of 250 psig, and a minimum temperature of 32°F.

The following items were cleaned during the demonstration:

- 1,000 bbl oil storage tank at Tensleep battery B-Tp-10
- Jensen 57 pumping unit at Well 64-65-SX-10
- Champion Model 720A road grader
- Wellhead at Well 67-1-SX-3

The oil storage tank was lightly coated with unrefined 30°API sour crude oil. The pumping unit was heavily overlaid with the same oil. The grader was covered with a mixture of spent hydraulic fluid and dirt. The wellhead was coated with a mixture of crude oil, paraffin and dirt, hardened over the years by heat from steamflooding operations.

DEMONSTRATION

Both days were sunny with ambient temperatures ranging from 70°F to 95°F. Winds were less than 5 MPH and there was no precipitation either day. A water truck with a 3,700 gallon capacity was used as a water supply for the icemaker. RMOTC personnel mobilized the water truck and assisted Ice Clean Systems, Inc. personnel in connecting their equipment to the water supply and in setting up their system. Ice Clean Systems, Inc. personnel instructed RMOTC personnel in operating the ICE 250 **J** Cleaning System. Personnel from both organizations videotaped the demonstration.

Cleaning operations began with the 1,000 barrel (bbl) oil storage tank. This tank had been sprayed with unrefined sour crude oil during a production upset. The original tank paint, a light beige color, had been completely covered with a thin layer of crude oil. Two panels, each measuring about 4' by 5', were cleaned in approximately 20 minutes. Although the cleaned surface had been permanently oil-stained by the oil spill, the ICE 250 **J** Cleaning System removed all surface oil and left the surface suitable for repainting.

The demonstration on the pumping unit at Well 64-65-SX-10 was more striking. This unit had been coated with sour crude oil during the same production upset that affected the oil storage tank. The unit was cleaned beginning at the base, proceeding up the support legs and ending with the horse head. As cleaning began, at the base of the unit, there was no noticeable pooling or collecting of water. Oil was quickly removed over a 30-minute period. At the end of the cleaning process, it was observed that the unit was nearly spotless, there was no oily residue and a minimal amount of waste had collected around the unit's base. No paint was removed during the cleaning procedure.

Subsequent cleaning efforts on the road grader and the wellhead using the ICE 250 **J** system produced similar positive results.

WASTE DISPOSAL

Cleaning equipment using ice as opposed to steam or pressure washing alleviates waste disposal concerns associated with cleanup operations. Although the majority of oil field wastes are exempt under 40 CFR 261.4 (b)(5) even accumulation of exempt wastes may have a direct bearing on an operator's generator status under the Resource Conservation Recovery Act (RCRA).

Operators do not want to store and treat large quantities of petroleum contaminated soils (PCS) formed during spill events, or wastewater derived from tank and equipment cleanups. Before PCS can be reused they must be sampled and tested for total petroleum hydrocarbon content and landfarmed until the minimum regulatory limit is reached. Treating soils is only allowed in a landfarm permitted to receive PCS, and only those soils that can pass a paint filter test. Although onsite landfarming is an option, it requires special

permission from state regulatory agencies. Both storage and landfarming require additional resources in terms of personnel, equipment, outside testing services. Wastewater from tank and equipment cleaning must be contained onsite until it can be disposed. Disposal methods include evaporation or injection in an Underground Injection Control (UIC)-permitted well. Either option requires a commitment of labor, equipment, and power resources. In either case, these direct costs to the operator, which in today's industry of small companies with reduced infrastructures and budgets the resources may not be available.

In all four demonstrations cleaning jobs, the ICE 250**J** Cleaning Machine produced very little waste. The amount of observed residual moisture from this system was small.

CONCLUSION

The test of the ICE 250**J** Cleaning Machine demonstrated that this technology effectively removes unrefined crude oil and dirt from a variety of oil field equipment. The ICE 250**J** Cleaning Machine did not damage the surfaces or equipment cleaned. No specialized site or equipment preparation was required, other than providing a water supply for the icemaker. Cleaning operations did not create waste in sufficient quantities to require any further disposal. The machine was safe, easy to operate and did not require specialized safety equipment.

DISCLAIMER